ADAPTING TO GLOBAL CHANGE
IN THE MEDITERRANEAN HOTSPOT
Seville 18, 19, 20th September 2013

Responses to past global change

MAMMALS, VEGETATION AND CLIMATE DURING THE LAST TEN MILLION YEAR IN THE MOST SOUTHWESTERN EXTREME OF THE EUROPA (BETIC CORDILLERA)

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Abstract

The capacity of mammal morphology to conserve indirect vestiges of habitats in which they live makes morphology a perennial factor, capable of identifying past habitats as a consequence of the fact that, for energy laws, morphologies are designed to seek the lowest energy consumption according to the ecological function that they serve, and derive the greatest benefit for the individual. The more similar the ecological functions of individuals are in all their energy parameters, the greater will be the resemblance in form of the organ that carries out these identical ecological functions. The Biocenogram method consists of a double-entry table relating: (1) vegetation, defined by their greater or lesser capacity of being food and shelter for mammals. (2) Mammal species from the area studied. (3) Quantity of benefit (energy) that mammals gain from their habitats. The biocenogram uses the plant habitats as an intermediate premise of the relationship between mammal morphology and climatic conditions, made explicit using the climatic categories cold, warm, wet, dry. These are quantified in temperature by the parameters Warm (Wa) and Cold (Co), and in the wet rainy weather by the parameters Wet (We) and Dry (Dr). The morphoclimatic parameters is a data group was unknown until the time that the biocenogram method was proposed. The system of morphoclimatic units: Mammal Climatic Unit, abbreviated (MCU or mcu).This is defined as the minimum climatic conditions (the wet rainy weather in mm/year and temperature in ºC) existing in a habitat of minimum surface area (expressed in m2), where a morphological unit (body mass in Kg/m2) represented by a single mammal species living under the same conditions of use and viability (expressed in Joules: Kg m2/s), and which in practice are identified with a constant number of individuals in the population, or with a growth equal to 0.

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ADAPTIN TO GLOBAL CHANGE IN THE MEDITERRANEAN HOTPOT
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1. Definition of Biocenogram viewed as a perennial factor of morphology and its ecological function

The Biocenogram method consists of a double-entry table relating: (I) habitat vegetation, (II) mammal species, and (III) quantity of benefit (energy) that mammals gain from their habitats.

Biocenogram Table

I:HABITATS. **A**, tundra and cold desert (high mountain). **B**,cold stepps with trees (Alpine -type grassland,few trees). **C**, conifer forests. **D**,deciduos forests. **E**,sclerophylous forest, Querqus, thermophilous pine. **F**,temperate steppe (meadow/savanna type). **G**, dry steppe (shrubland type). **K**, deserts and arid zones. **H**, cold continental waters (streams, riverbank). **I**, warm continental waters (lagoons, pools, marshy areas).

II. MAMMAL species list

III. THE ECOLOGICAL-PREFERENCE FORMULA:

It is the replacement of the habitat: AB.CDE.FGK.HI by the degrees of the benefit by quality evaluation keys:

Key (2) - ***Breeding habitat***. Habitats where females give birth and raise their young.
Key (1) - ***Feeding habitat***. This is used only in transitory or seasonal way. **Key (0) - No use**

Example:ecological-preference formula of a forest mammal is **00.222.000.00**

(The points, used between numbers of the formula, they have the function only of facilitating their identification and reading)

2. The digitalization of the mammals biocenosis in the ecosystem:

The Standar Biocenogram

HABITATS A B C D E F G K H I

In aquatic habitats (I and H), the asterisk(*) is indifferently equivalent to the values (0) and (1)

MAMMAL species list: keys (I, II, III, IV)

I. Biologically permutations of the **one** breeding habitat (2) with the feeding habitats (1, 11, 111, 1111, 11111), if the habitats number that mammal specie cover is bigger than five, the animial behaviour is erratic (Y)

2	20.000.000.**	02.000.000.**	00.200.000.**	00.020.000.**	00.002.000.**	00.000.200.**	00.000.020.**	00.000.002.**
21	21.000.000.**	02.100.000.**	00.210.000.**	00.021.000.**	00.002.100.**	00.000.210.**	00.000.021.**	00.000.002.20
12		12.000.000.**	01.200.000.**	00.120.000.**	00.012.000.**	00.001.200.**	00.000.120.**	00.000.012.**
211	21.100.000.**	02.110.000.**	00.211.000.**	00.021.100.**	00.002.110.**	00.000.211.**		
121		12.100.000.**	01.210.000.**	00.121.000.**	00.012.100.**	00.001.210.**	00.000.121.**	
112			11.200.000.**	01.120.000.**	00.112.000.**	00.011.200.**	00.000.112.**	
2111	21.110.000.**	02.111.000.**	00.211.100.**	00.021.110.**	00.002.111.**			
1211		12.110.000.**	01.211.000.**	00.121.100.**	00.012.110.**	00.001.211.**		
1121			11.210.000.**	01.121.000.**	00.112.100.**	00.011.210.**	00.001.121.**	
1112				11.120.000.**	01.112.000.**	00.011.200.**	00.011.120.**	00.001.112.**
21111	21.111.000.**	02.111.100.**	00.211.110.**	00.021.111.**				
12111		12.111.000.**	01.211.100.**	00.121.110.**	00.012.111.**			
11211			11.211.000.**	01.121.100.**	00.112.110.**	00.011.211.**		
11121				11.121.000.**	01.112.100.**	00.011.210.**	00.011.121.**	
11112					11.112.000.**	01.111.200.**	00.111.120.**	00.011.112.**

Y = (erratic behaviour)

II. Biologically permutations of the **two** breeding habitat (22) with the feeding habitats (1, 11, 111, 1111, 11111), if the habitats number that mammal specie cover is bigger than five, the animial behaviour is erratic (Y)

22	22.000.000.**	02.200.000.**	00.220.000.**	00.022.000.**	00.002.200.**	00.000.220.**	00.000.022.**	00.000.000.22
221	22.100.000.**	02.210.000.**	00.221.000.**	00.022.100.**	00.002.210.**	00.000.221.**		
122		12.200.000.**	01.220.000.**	00.122.000.**	00.012.200.**	00.001.220.**	00.000.122.**	
2211	22.110.000.**	02.211.000.**	00.221.100.**	00.022.110.**	00.002.211.**			
1221		12.210.000.**	01.221.000.**	00.122.100.**	00.012.210.**	00.001.221.**		
1122			11.220.000.**	01.122.000.**	00.112.200.**	00.012.210.**	00.001.221.**	
22111	22.111.000.**	02.211.100.**	00.221.110.**	00.022.111.**				
12211		12.211.000.**	01.221.100.**	00.122.110.**	00.012.221.**			
11221			11.221.000.**	01.122.100.**	00.112.210.**	00.011.221.**		
11122				11.122.000.**	01112.200.**	00.111.220.**	00.011.122.**	

Y = (erratic behaviour)

III. Biologically permutations of the **three** breeding habitat (222) with the feeding habitats (1, 11, 111, 1111, 11111), if the habitats number that mammal specie cover is bigger than five, the animial behaviour is erratic (Y)

222	22.200.000.**	02.220.000.**	00.222.000.**	00.022.200.**	00.002.220.**	00.000.222.**		
2221	22.210.000.**	02.221.000.**	00.222.100.**	00.022.210.**	00.002.221.**			
1222		12.220.000.**	01.222.000.**	00.122.200.**	00.012.220.**	00.001.222.**		
22211	22.211.000.**	02.221.100.**	00.222.110.**	00.022.211.**				
12221		12.221.000.**	01.222.100.**	00.122.210.**	00.012.221.**			
11222			11.222.000.**	01.122.200.**	00.112.220.**	00.011.222.**		

2222 o more = Z (ubiquitous species)

IV. **Four** o more breeding habitat is equal to the ubiquitous species and it does not have logic the permutations with feeding habitats

YZ (erratic and ubiquitous)

Attention! **red** ecological-preference formula in the Standar Biocenogram, they integrate the species group site or species group living in any region (Group φ= species **a**... to species **n**)

3. The Habitats Indexes (HI)

It indcate the % benefits obtained for each species group in each habitat of the ecosystem.

(Σ of the each numbers column of the ecological-preference formula)*100 / (Σ all columns numbers)

Example: Habitat index HI groupe (φ)

A (HI =2.5%);B (HI =12.3%);C (HI =13.9%);D (HI =17.2%);E(HI =23%);F (HI =17.2%);G(HI =5.7%);K (HI =0.0%);H (HI =4.9%);I (HI =3.3%).

Σ2.5%A+12.3%B+13.9%C+17.2%D+23%E+17.2%F+ 5.7%G+ 0.0%K+ 4.9% H, 3.3% I= 100%

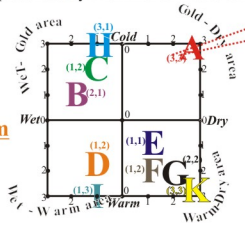
4. Morphoclimatic parametres (Scale: cold+warm = 100; dry+wet = 100)

They expressed as Mammal Climatic Unit system (MCU)

The temperature criterion. The transformation the **quality warm** into **parameter Warm** is a temperature equal to or higher than the one existing in sclerophylous forest. The **quality cold** is transformed into a **parameter Cold** with a temperature lower than the one existed in the sclerophylous forest. Cold + Warm = 100. It is represented in a new units system: Mammal Climatic Unit System.

The rainy weather criterion. The **quality wet** is transformed into a **parameter Wet** when in the habitat precipitation is equivalent to greater than evaporation. The **quality dry** is transformed into a **parameter Dry** when in the habitat precipitation indicates is equivalent or greater evaporation than precipitation. Wet + Dry =100 It is represented by Mammal Climatic Unit System

Climatic Scale to HABITATS classification in the Eurasian biocenogram



A = (3·cold) - (3·dry)
B = (2·cold) - 1wet
C = 1cold - (2· wet)
D = 1warm - (2·wet)
E = 1warm - 1dry
the measurement unit
F = 1warm - (2·dry)
G = (2·warm) - (2·dry)
K = (3·warm) - (3·dry)
H = 1cold - (3·wet)
I = 1warm -(3·wet)

Climatic parameter definition. It is the result of adding the indices of habitat (HI) corresponding to habitats classified the climatic category that has the same name as the parameter.

Example. **Parameter Cold** is the sum of the Habitat Indices (ecological preferences) of the habitats which contain the category cold in the habitat climatic classification.

First step calculation: Cold, Warm, Dry, Wet

		Example: φMammal group	
Cold	= 3*(HI-A) + 2* (HI-B) + HI- C+ HI-H	Cold = 3·2.5 + 2·12.3 + 13.9 + 4.9	= 50.9
Warm	= HI-D + HI-E + HI-F+2*(HI-G)+ 3*(HI-K)+HI-I	Warm = 17.2 + 23+17.2 +2·5.7+3·0.0 +3.3	= 72.1
Dry	= 3*(HI-A) + HI-E + 2*(HI-F) + 2*(HI-G)+ 3* (HI-K)	Dry = 3· 2.5 + 23+2·17.2 +2·5.7+3·0.0 =	76.3
Wet	= HI-B + 2*(HI-C) + 2*(HI-D) + 3*(HI-H)+3*(HI-I)	Wet =12.3 + 2. 13.9+2·17.2 +3. 4.9+3·3.3 =	99.1

Second step. The MCU calculation: Cold +Warm = 100 and Dry+ Wet=100

Cold (MCU) = cold*100/(cold+warm)
Warm (MCU)= warm*100/(cold+warm)

Dry (MCU) = dry *100/(wet+dry)
Wet (MCU) = wet *100/(wet+dry)

Example: Result Species groupe (φ)

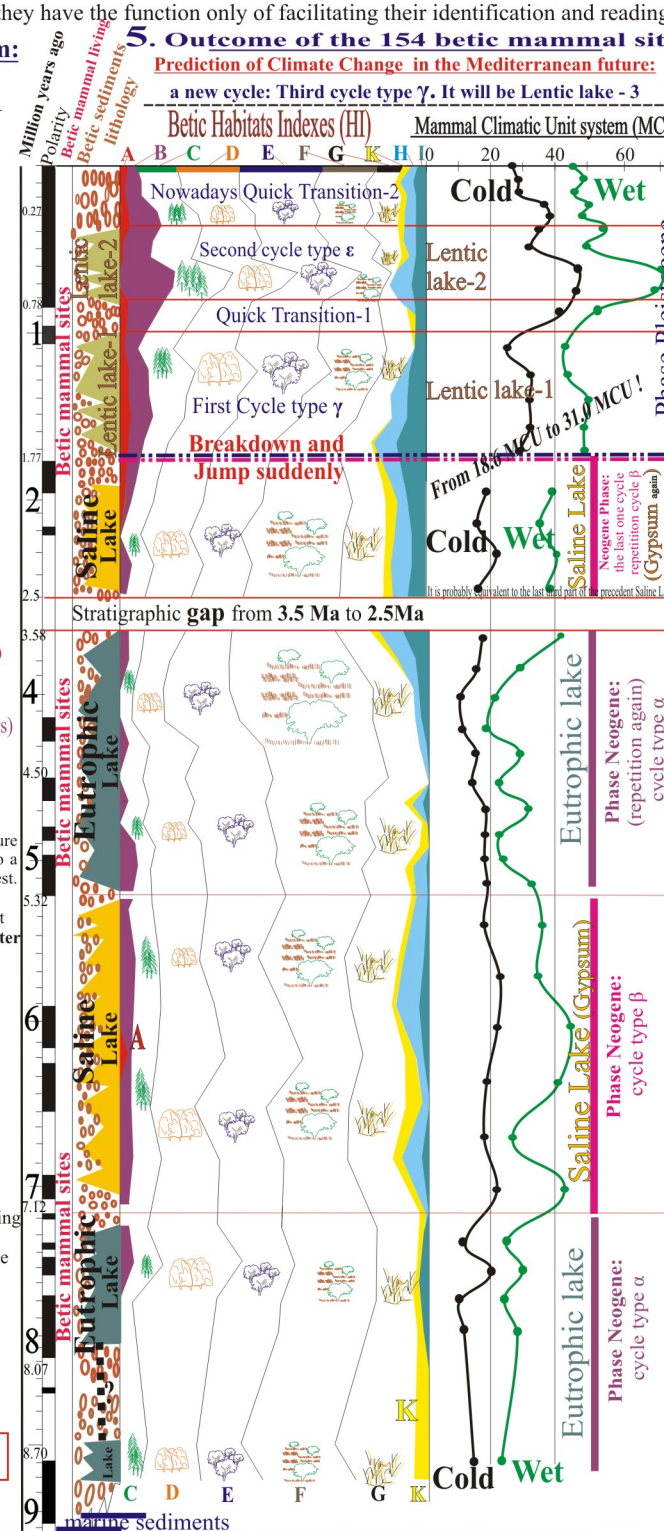
Cold=**41.4** MCU Warm=**58.6** MCU

Dry=**43.5**MCU Wet=**56.5** MCU

5. Outcome of the 154 betic mammal sites

Prediction of Climate Change in the Mediterranean future:

a new cycle: Third cycle type γ. It will be Lentic lake - 3



Conclusion. The poster quantifies in MCU, the climatic conditions at today and the near future in the SouthWestern of Europe

This Poster is expleined with detail in the book: **Biostratiphyc Scale and Climate Change at Betic Cordillera**
(Ruiz Bustos, 2011, Bubok Publishing S.L., Madrid, Spain. 412pp)